ing conditions at Ramleh over the same period differs from the previous one in that the ordinates represent the hours of the day. Here, also winds of equal intensity are joined by curves. Winds of over 6 meters per second are sufficient to carry with them clouds of dust and these dust storms are shown by hachure.—*C. L. M.*

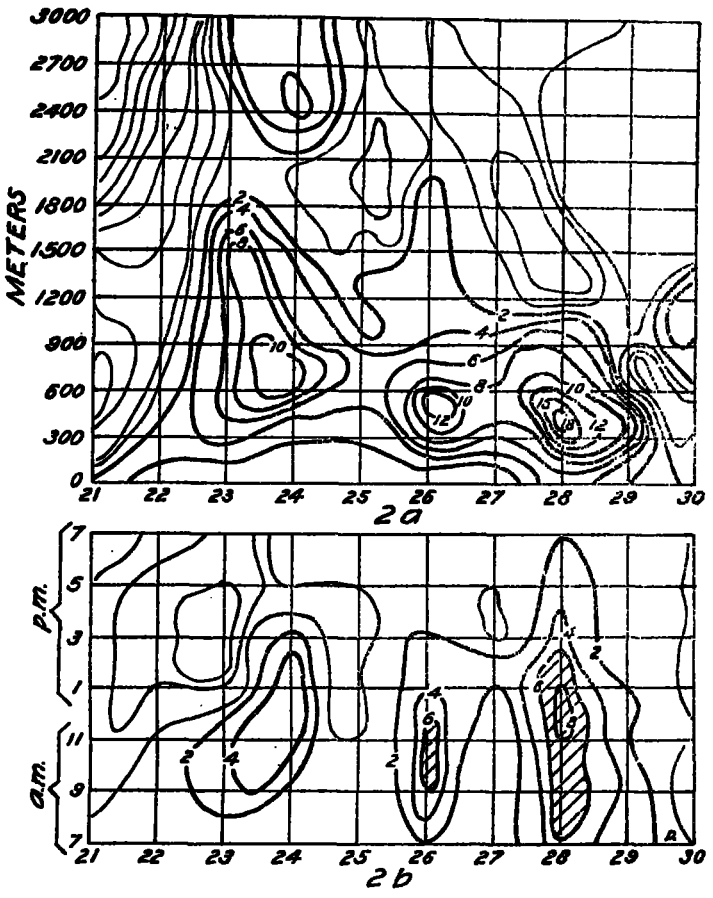

FIG. 2a.—Lines of equal wind strength above Ramleh, March 21-30, 1917; heavy lines being sirocco wind, light lines, sea wind.
FIG. 2b.—Lines of equal surface wind strength at Ramleh, March 21-30, 1917; heavy lines being sirocco wind, light lines, sea wind.

THE COOL BREEZE OF THE SHADOW OF THE CUMULUS.[1]

By W. J. HUMPHREYS.

[Weather Bureau, Washington, D. C., Apr. 21, 1921.]

In respect to many things it may be sanely philosophical to "take the good the gods provide thee" and ask no questions, but in meteorology, at least, such *sans souci* is unscientific, however great our gratitude. And so it happens that when, on a sweltering day, the passing cumulus, for instance, brings its grateful breeze we ask whence it came and how. Well, the answer is not entirely simple, not all in just a word or two, but still clear enough to give something of that mental satisfaction that comes with every conscious understanding. Essentially it is as follows:

During calm, clear summer days, the surface of the earth, especially in more or less arid regions, becomes strongly heated by the sunshine. This heated surface in turn correspondingly warms the adjacent air and thereby establishes a proportionately vigorous vertical convection in the lower atmosphere. Convection, however, can not extend through the heated surface, hence the very lowest air is rather stagnant and superheated. Indeed, while the amount of convectional mixing rapidly increases with elevation, nevertheless it often is still imperfect at a level of even several hundred feet. Throughout all that region, however, in which convection is perfect a slightly warmed mass of air would continue to rise, and a cooled mass continue to fall, being at each level a little warmer or a little cooler, respectively, than the then adjacent atmosphere of the same level.

Now, obviously, free air (air at an appreciable altitude above the surface) in the sunshine usually is a trifle warmer than is the neighboring air at the same level within the shade of a cumulus. Hence, in general, the former is ascending and the latter descending, except just under the forward base of the cloud—a mere detail that need not here be further considered. Clearly, too, the descending air must spread out near the surface—spread out because it can not blow into the ground—and it is this spreading out of the descending air that constitutes the gentle breeze that so frequently accompanies the shadow of the cumulus cloud.

The refreshing drop in temperature that also accompanies the shadow of the cumulus is yet to be explained.

Since the air is heated mainly by the surface of the earth which itself was warmed by the absorption of solar radiation, and since the very lowest air is not vigorously mixed by convection, it follows that during a calm summer day, sand and barren soil, the adjacent air, and even one's outer clothing, all become quite hot when exposed to the sunshine—often 10 degrees or more hotter than the free air 50 to 100 feet above. Within a few minutes, however, after a heavy shadow comes on nearly all this excess of temperature has disappeared—lost by radiation, convection, and conduction. Hence the breeze due to the descending air within the cumulus shadow, explained above, is really cool, in comparison to the superheated surface air out in the sunshine; it is, in truth, the well-known and ever-grateful cool breeze of the shadow of the cumulus.

[1] Presented before the American Meteorological Society at Washington, Apr. 21, 1921.

BIBLIOGRAPHIC NOTES ON THE TEMPERATURE CHARTS OF THE UNITED STATES.

551.524 (084.3) (73)

By ROBERT DE C. WARD.

[Harvard University, Cambridge, Mass., June 8, 1921.]

In connection with a general study of the climatology of the United States upon which the writer has for some years been engaged, brief references have from time to time been made on the various available isothermal charts of this country. The publication of the following notes on these charts may be of interest to others for two reasons. First, because of the completion, for the section on climate of the new *Atlas of American Agriculture*, of a wholly new set of temperature maps,[1] and, secondly, because no list of the earlier charts seems heretofore to have been printed. The following bibliography contains reference to all the charts to which the writer has, up to the present time, been able to gain access. There may be, and doubtless are, omissions.[2] It is not the purpose of

[1] Not yet published.
[2] Readers of the REVIEW will confer a favor on the writer by notifying him of any such.

the present note to include reference to the numerous isothermal charts for individual States or districts, which have from time to time appeared in various scattered publications,[3] nor to isothermal maps for individual months which have for many years been regularly included in the successive issues of the MONTHLY WEATHER REVIEW.

For convenience, and in order to make the present bibliographic note somewhat more useful to students generally, brief reference is made (B) to a few miscellaneous temperature charts of the United States, and (C) to the standard world temperature charts which are necessary in making any comparative study of the temperature conditions of the United States in relation to those of other parts of the world.

A. MEAN ANNUAL, SEASONAL, AND MONTHLY ISOTHERMAL CHARTS OF THE UNITED STATES.

1844. Samuel Forry.

"Researches in Elucidation of the Distribution of Heat over the Globe, and specially of the Climatic Features peculiar to the Region of the United States." *Amer. Jour. Sci.*, 1844, Vol. 47, pp. 18–50, 221–241; pls. 2. Pl. I illustrates "the general laws of temperature throughout the United States" by means of five lines of equal temperature, one ("isothermal") for the year; two ("isocheimal") for winter and two ("isotheral") for summer.

1855. Lorin Blodget.

"Distribution of Temperature and Explanation of the Isothermal Charts." *Army Met. Register, for Twelve Years, from 1843 to 1854, inclusive.*" Washington, D. C., 1855, pp. 688–733. Annual and four seasonal charts, "designed and prepared by Lorin Blodget under the direction of Bvt. Brig. Gen. Thomas Lawson, Surgeon General, U. S. A." Isotherms (in red) are drawn heavy for every 5°; light for intervals of less than 5°, and in broken lines where "doubtful." The "minimum or lowest position" and the "maximum or most northern position" of certain isotherms are also shown. Blodget's "isothermal illustrations" were "first presented to the American Association for the Advancement of Science in 1853," but the charts were not published in the proceedings of the association.

1857. Lorin Blodget.

"Climatology of the United States . . . with Isothermal and Rain Charts for each Season, the Extreme Months, and the Year . . . ," etc. Large 8vo. Philadelphia, 1857. Pp. 257–316 concern "distribution of heat in the United States, monthly and for the seasons, with explanation of the isothermal charts," of which there are five. These are essentially the same as those originally included in the *Army Meteorological Register*, above referred to. The "number of series of observations consulted" for the United States was 583 (p. 33). The mean temperatures (given in the tables) were "principally obtained from the simple arithmetical mean of the several daily observations, and without correction by any scale derived from the daily curve of temperature" (p. 36). The observations were made at various hours, thrice daily, twice daily, and some means were obtained from the daily extremes. The charts are obviously very incomplete and inaccurate in the light of present-day knowledge. Some isotherms divide; many are only partly drawn, and remain "hanging." In view of the date of publication, however, Blodget's charts and his discussion are remarkably complete. Another chart (opposite p. 210), for purposes of "comparison of temperatures for the temperate latitudes of the northern hemisphere," shows the January, July and mean annual isotherms between latitudes 20° and 80° N.

1874. Charles A. Schott.

"Temperature Chart of the United States. Showing the Distribution, by Isothermal Lines, of the Mean Temperature for the Year. Constructed under the direction of Professor Joseph Henry, Secretary, Smithsonian Institute, by Charles A. Schott, assistant, U. S. Coast Survey, in October, 1872." In Francis A. Walker: "Statistical Atlas of the United States, based on the Results of the Ninth Census, with Contributions from many Eminent Men of Science and Several Departments of the Government." Three parts. Washington, D. C., 1874, part I, chart VII. This chart first appeared on page 579 of the quarto volume of the Ninth Census. It is essentially the same as the mean annual map referred to in the following paragraph. Isotherms are drawn for every 4° F. The chart bears the legend, "Reengraved and printed for the Statistical Atlas of the United States, with Permission of Professor Joseph Henry, Secretary, Smithsonian Institution."

1876. Charles A. Schott:

"Tables, Distribution and Variation of the Atmospheric Temperature in the United States, and some Adjacent Parts of America, collected by the Smithsonian Institution, and discussed under the direction of Joseph Henry, Secretary." *Smithson. Contr. to Knowledge.* No. 277. 4to. Washington, D. C., 1876, pp. 1–345. This is one of Schott's two well-known contributions to our knowledge of the climatology of the United States, the other being his study of precipitation, also published by the Smithsonian Institution. The mean annual temperatures are shown by "isothermal curves" for every 4° from 36° to 76° F.; the winter temperature by "isocheimal curves" for every 4° from 4° to 72° F.; and the summer temperatures by "isothermal curves" for every 4° from 56° to 88° F. Five shades of brown are used to emphasize the temperature distribution. For the year, nearly 1,300 series of observations were used; for the winter, about 1,450, and for the summer about 1,500. East of the Mississippi, all series of five years and over are given to the nearest tenth of a degree F., and of less than five years to the nearest degree. The data are not reduced to sea level, because actual temperature "affects agriculture and other pursuits," and the charts are not designed to show "any artificial distribution under special qualified conditions such as the reduction to sea level." Schott makes a number of other interesting comments, such as that "each curve must be continuous, no matter how tortuous its course may be, that is, it can not abruptly come to an end." The importance of having a reliable hypsometric chart is emphasized; the lack of it is "seriously felt."

1881. A. W. Greely:

"Isothermal Lines of the United States, 1871–1880, by 1st Lieut. A. W. Greely, Acting Signal Officer." *Professional Papers, U. S. Signal Service.* No. 2, 4°. Washington, D. C., 1881. Twelve monthly charts, with isotherms for every 5° interval. "No similar charts have been recently published" (Preface). "No means have been used which do not cover at least three consecutive years, and but very few of less than six years duration. * * * It was deemed best not to correct for want of uniformity in methods of deducing daily means. * * * The isotherms where crossing mountain ranges express the temperature, not of the peaks, or elevated or isolated stations, but of adjacent valleys. * * * The method has been adopted of connecting mean temperatures of equal value in contiguous valleys or plateaus by a nearly direct route, giving the lines only such curves and direction as has been suggested by the data collected. * * * Even were it desirable to draw lines based on elevations and the very scanty data available from elevated stations, the size of these charts would have precluded it." The observations used were all thrice daily, but taken at various hours. No general discussion accompanied this set of charts. The January and July charts have been several times reproduced, *e. g.*, in *A. W. Greely:* "American Weather," 8°, New York, 1888 (Charts V, VI), and in F. Waldo: "Elementary Meteorology," 4to, New York, 1896, Figs. 95, 96.

1886. William Ferrel:

"Report of Professor William Ferrel, Assistant, on Reduction of Barometric Pressure to Sea Level and Standard Gravity." *Appendix 28, Annual Report of the Chief Signal Officer for 1886.* 4°. Washington, D. C., 1886, pp. 221–237. Three sea-level isothermal charts, for the year, January and July, for use in barometric reductions. The reduction formula used is 1° in 600 feet. "This is only about one-half of the usual rate obtained in various parts of the world * * * but for the reduction of the plateau stations of the western part of the United States this rate is evidently much too great." Isotherms are drawn for every 5° F. (year, 35°–70° F.; January, 0°–60°; July, 65°–85°).

1886. J. Hann:

"Atlas der Meteorologie," *Berghaus' Physikal-Atlas, Abt. III.* Gotha, 1887. This atlas contains three charts of mean annual, January and July isotherms for North America, colored, the lines

[3] As examples of such special charts mention may be made of the following: *Alexander Winchell:* "The Isothermals of the Lake Region," *Proc. Amer. Ass. Adv. Sci.*, Vol. 19, 1870, pp. 106–117 (with detailed isothermal charts for January and July, still of interest), and of the large-scale set of annual and seasonal isothermal charts of Maryland, including Delaware and the District of Columbia ("Climatic Charts of Maryland, including Delaware and the District of Columbia, together with a Map showing the Distribution of the Geological and Soil Formations," 18x33 ins., *Maryland Weather Service*, Baltimore, Md., 1893. 3 pp. 10 ch. 1 map. *Reviewed; Amer. Met. Journ.*, Vol. 10, 1893–94, pp. 489–490),

being drawn for every 2° C., and one chart of the January isotherms for the eastern United States (on a somewhat larger scale), together with the lines of equal annual minimum temperatures. The data used were those available up to 1884, and the reduction formula is 0.5° C. per 100 meters (1° F. for 365 feet). These four charts are reproduced in the "Atlas of Meteorology" (1899), Plate 7, with explanatory text (p. 12).

1891.

"Normal Temperature Charts, by Decades, for the United States and the Dominion of Canada," prepared under the direction of Brig. Gen. A. W. Greely, Chief Signal Officer, fol., Washington, D. C., 1891. Charts 72. These show the normal temperatures for every 5° F., by decades, three decades to each month, at 8 a. m. and 8 p. m., 75th meridian time, and were prepared by A. J. Henry and P. C. Day. These charts were in their day of great interest and value, but have now been almost completely forgotten, and are obviously quite out of date.

1897.

Normal Sea-Level Temperatures (annual and monthly). Annual Report of the Chief of Weather Bureau for 1896–97, Washington, D. C., 1897, p. 279, Charts V–XVII. "Normal or average values of temperature were published in the Report of the Chief of Weather Bureau, 1891–92; inasmuch, however, as five years' additional observations are now available, it is deemed profitable to publish new normals, both in tabular and graphic form * * *. The monthly and annual averages of temperature for 140 Weather Bureau stations are given * * *. The figures represent the simple arithmetical means of the observed temperatures for the number of years given in the column * * *. The observations cover the epoch 1871 to 1895." The table shows varying periods of years, from six to twenty-six.

1899.

"Atlas of Meteorology." (Bartholomew's Physical Atlas, Vol. III, fol. London, 1899. Pl. 8; text, p. 12.) Mean monthly isotherms of the United States, in colors. These maps were originally published in the *Report of the Chief of the Weather Bureau for 1896–97*. (See above.) "Dr. Buchan's manuscripts have been used to extend the lines both north and south of the Union frontier * * *. In the case of the United States, the reduction formulae used were December–February, 1° F. for 667 feet; March–May, September–November, year, 1° F. for 500 feet; June–August, 1° F. for 400 feet. The suggestion of Mr. Park Morrill was also adopted,[4] whereby these formulae were modified by local corrections determined as follows: The normal reduced temperatures were charted for a considerable extent of country and isotherms drawn. These are more or less wavy, and irregular, as a result of local peculiarities of temperature. Through these wavy lines smooth lines are drawn with a free hand. The isothermal chart thus formed is believed to closely approximate to the chart of sea-level temperatures.

1906(?).

"Climatic Charts of the United States." U. S. Weather Bureau. Washington, D. C. 10 x 16 ins. Unbound. There are three charts showing the "normal temperature of the air at the surface of the earth" for the year, January and July. These charts were first issued about 1906 and have been reprinted several times, but there has been no new edition. The legend on one set of these charts in the writer's collection says: "Compiled from observation at the regular Weather Bureau and selected cooperative stations between 1871 and 1908." On another set of these charts there is no reference to the period covered by the observations, but the writer is informed by Mr. P. C. Day, of the Weather Bureau, that the basic period is 33 years, from 1873 to 1905, inclusive. Isotherms are drawn for every 5° F. These charts are now the Weather Bureau "standard," and will remain so until the new temperature maps prepared for the *Atlas of American Agriculture* are finally given publication.

1906. Alfred J. Henry:

"Climatology of the United States." Bulletin Q. U. S. Weather Bureau. 4to. Washington, D. C., 1906. Pls. X–XII. Three charts of the normal surface temperatures for the year, January and July, with isotherms for every 5°. The text (pp. 25–26) discusses the mean annual chart only. These charts were based upon the records of the period 1871–1903. In general no record of less than 24 years was used.

[4] Annual Meteorological Summary, 1895, p. 493.

B. MISCELLANEOUS TEMPERATURE CHARTS OF THE UNITED STATES.

The following bibliography includes some of the more important miscellaneous temperature charts which may be useful in a study of the temperature conditions of the United States.

"Highest Temperatures ever Observed at the Regular Weather Bureau and Selected Cooperative Stations (Fahr.)." "Lowest Temperatures ever Observed at the Regular Weather Bureau and Selected Cooperative Stations (Fahr.)." *Climatic Charts, U. S. Weather Bureau.* One set of these two charts, which are the present "standard" for the United States, bears the legend "highest (lowest) temperatures recorded in the shade at the regular Weather Bureau and selected cooperative stations since their establishment to include December 31, 1908, except in case of stations closed prior to that date, covering in extreme cases a period of about 38 years." Another set of the charts bears the legend: "This chart represents the highest (lowest) temperatures ever recorded in the shade at the regular Weather Bureau and selected cooperative stations," without mention of the period covered by the observations.

Bulletin Q (U. S. Weather Bureau, 1906) includes a chart of absolute maximum temperatures (Pl. XIII) and one of absolute minimum temperatures (Pl. XIV). The discussion (pp. 26–29) does not mention the period covered by the observations, but reference is made to Table II (pp. 88–92) as containing "the numerical values for a number of the principal stations," and there is a statement that "in the preparation of the charts a few records were used that do not appear in the table." The table bears the caption "Absolute Maximum and Minimum Temperatures for Selected Stations, with Year of Occurrence, 1871–1903." The number of years of record varies, but is generally between 25 and 33. Another short table (p. 28) gives "Extremes of Temperature in Mountain Districts," the stations including Mount Washington, N. H., Mount Mitchell, N. C., Pikes Peak, Colo., Summit, Calif., and others. The two charts in *Bulletin Q*, therefore, do not cover as long periods as do those which form part of the "Climatic Charts." Hence, the former naturally show somewhat lower maxima over some sections, and somewhat higher minima. An earlier publication on maximum and minimum temperatures was that entitled "Charts Showing Maximum and Minimum Temperatures, by Decades, for All Years," Prepared under the Direction of Brig. Gen. A. W. Greely, Chief Signal Officer fol. Washington, D. C., 1891. Chart 37. The period covered is 1872 to June 30, 1891; the year and date of occurrence are shown in figures; no lines are drawn. One chart (37) shows "the chief maxima and minima temperatures in the United States and the Dominion of Canada from the beginning of the use of self-registering theremometers (generally in 1872 in the United States) to the present time" (1891).

Absolute maximum and absolute minimum temperature charts were also included in Greely's "*American Weather*" (1888), Charts VII and VIII, and bear the legend, "Maximum (Minimum) Temperatures ever observed, 1871–1888." These are also included in Waldo's "Elementary Meteorology" (1896), Figs. 97 and 98 ("after Greely").

Other charts which are readily accessible and are still useful, in bibliographic and historical studies although

rather out of date at the present time, are the following: In Greely's "*American Weather:*" "Continuance of Daily Mean Temperature above 50° F.," Chart IX (Lines are drawn for the periods of months; figures are given for days); "Continuance of Daily Mean Temperature below 32°F.," Chart X; "Variability of Temperature for January," Chart XI (mean diurnal; lines for 1° intervals). In Waldo's "*Elementary Meteorology*": "Absolute Amplitude of Shade Temperatures (after Greely)," Fig. 99; "Variability of Average Daily Temperatures in January in the United States (after Greely)," Fig. 101; "Relative Frequency of Falls of Temperature of over 20° in 24 hours (after Russell)," Fig. 102. In *Bulletin Q:* "Mean Maximum Temperatures for July," Pl. XV; "Mean Minimum Temperatures for January," Pl. XVI; "Absolute Range in Monthly Mean Temperature, January," Pl. XVII; "Absolute Range in Monthly Mean Temperature, July," Pl. XVIII.

The earliest publication of temperature charts of the United States for "popular" use seems to have been that of Dr. Charles Denison, who, in 1884 (Rand, McNally & Co., Chicago), issued a set comprising an annual and four seasonal climatic maps, showing, by lines and by colors, the distribution of temperature, rainfall, cloudiness, and relative humidity, and by arrows, the prevailing winds. The maps and tables were "compiled from data of the Signal Service Bureau," obviously very fragmentary at that early date. Reviewed by W. M. Davis, in *Amer. Met. Journ.*, vol. 1, 1884–85, pp. 545–546. A so-called "popular edition," with additions, was published in 1893 (large 8°, 1893, pp. 47).

C. ANNUAL AND MONTHLY ISOTHERMAL CHARTS OF THE WORLD.

No study of the temperatures of any single country is complete unless it includes a comparison with those of other parts of the world. For this reason the following references to the present standard world temperature charts are here added.

The one uniform and complete series of annual and monthly isothermal charts is the "Challenger" set, originally published in the *Report on Atmospheric Circulation*, "*Challenger*" *Reports, Physics and Chemistry*, Vol. II, Edinburgh, 1889, and all reproduced in the *Atlas of Meteorology*, pls. 1 and 3 (text pp. 7, 9–10). The mean annual, January, and July charts have since been reproduced in a large number of publications. These charts are based on observations taken during the same period of 15 years, 1870–1884, and a uniform reduction formula of 1° F. for 270 ft. (1° C. for 200 meters).[5]

No newer world charts of the mean annual maxima, mean annual minima, and mean annual extreme range than those of Dr. van Bebber, originally published in 1893, are available.[6]

These three charts are reproduced, in colors, in the *Atlas of Meteorology*, pl. 2, text, pp. 8–9, with the statement that "some corrections have been kindly communicated by the author" (i. e. Dr. van Bebber). Charts of this sort are obviously constructed with great difficulty, and it is hardly to be expected that a new series will be prepared in the near future.

The "standard" world charts of mean annual ranges and of isanomalous temperatures were constructed by former students of Professor W. M. Davis, of Harvard University, and under his direction. The mean annual range chart, based on the "Challenger" January and July isothermal charts, was the work of J. L. S. Connolly,[7] and is reproduced, in colors, in the *Atlas of Meteorology*, pl. 2, text, p. 8. It also appears in Davis's "*Elementary Meteorology*," fig. 18, and elsewhere. The isanomalous charts were constructed by S. F. Batchelder, and included the mean annual, January and July isonomalies.[8]

The January and July charts were the only ones printed, and these are reproduced, in colors, in the *Atlas of Meteorology*, pl. 2, text, p. 8, in Davis's "*Elementary Meteorology*," figs, 16 and 17, and elsewhere. The original chart showing the mean annual isanomalous lines, which has never been published, is in the Climatological Laboratory of Harvard University.

In the study of the larger temperature conditions of the United States, especially in relation to those of the world as a whole, the "thermal regions" of the late Dr. A. J. Herbertson are very useful.[9]

Dr. Herbertson's three essential maps are reproduced, on a large scale, in the series of *Oxford Wall Maps*.[10]

The map of the thermal regions of the world shows 10 different regions, indicated by different colors and divided according to the characteristics of their seasons, the distinguishing temperatures being over 68°; 50°–68°; 32°–50°; and below 32° (F.). These are actual temperatures, not reduced to sea level. The same wall map also shows the mean actual temperatures for January and for July, in colors, the critical actual temperatures being the same as those used in the thermal regions. Areas over 68° are pink; between 50° and 68°, yellow; between 32° and 50°, green; and below 32°, blue. On all three maps the critical *sea-level* isotherms of the "Challenger" charts are shown, for purposes of comparison between sea-level and actual temperatures.

LEVEL OF CONSTANT AIR DENSITY.[1]

By W. J. HUMPHREYS, Professor of Meteorological Physics.

[Weather Bureau, Washington, D. C.]

Sir Napier Shaw says[2] that at the level of 8 kilometers the density of the air "is equal all over the globe at all seasons of the year." Statistical evidence of the truth of this statement occurs in density-elevation tables by W. H. Dines,[3] and by Gregg.[4] I was unable, however, to find any general or theoretical proof of it, and therefore tried to prove it myself; and as this proof is both short and easy it may be worth passing along, even though it must bear the warning label "perhaps not new."

As is well known, both the composition and the sea-level pressure of the atmosphere are roughly constant from season to season and from place to place. Clearly

[5] Historical, bibliographical, and descriptive notes on various temperature charts will be found in the *Atlas of Meteorology* text, pp. 6–10. Reference may also be made to *E. W. Woolard:* "Historical Note on Charts of the Distribution of Temperature, Pressure, and Winds over the Surface of the Earth," *Month. Weather Rev.*, July, 1920, 48, 408–411.

[6] W. J. van Bebber: "Die Verteilung der Warmeextreme über die Erdoberfläche," *Pet. Mitt.*, vol. 39, 1893.

[7] J. L. S. Connolly: "A New Chart of Equal Annual Ranges of Temperature," *Amer. Met. Journ.*, vol. 10, 1893, 94, pp. 505–506, 1 ch.

[8] S. F. Batchelder: "A New Series of Isanomalous Temperature Charts, based on Buchan's Isothermal Charts," *ibid*, vol. 10, 1893–94, pp. 451–474, chs. 2.

[9] A. J. Herbertson: "The Thermal Regions of the Globe," *Geogr. Journ.*, vol. 40, 1912, pp. 518–532; reprinted in *Mo. Weather Rev.*, vol. 42, 1914, pp. 286–289; reviewed by *R. De C. Ward:* "A Note on the Classification of Climates," *Bull. Amer. Geogr. Soc.*, vol. 46, 1914, pp. 108–116.

[10] Oxford University Press; 60 x 40 inches, mounted on cloth. Three maps on one sheet.

[1] Presented at meeting of American Meteorological Society, Washington, D. C., Apr. 21, 1921.

[2] *Nature*, 1920. 106:436.

[3] *Geophys. Memoirs*, No. 13, p. 63, 1919.

[4] MONTHLY WEATHER REVIEW, Jan., 1920. 48:10.